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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION D—MECHANICAL SCIENCE AND ENGINEERING

THE meeting of the section for organization was held in Cobb Hall of the University of Chicago on December 30 and 31, 1907, and January 1, 1908. The vice-president of the section, Olin H. Landreth, professor of civil engineering, Union University, acted as chairman of the section. Dr. George F. Swain, professor of civil engineering, Massachusetts Institute of Technology, was elected councilor. Mr. George W. Bissell, dean of engineering, and professor of mechanical engineering, Michigan Agricultural College, was elected a member of the general committee. Mr. Arthur H. Blanchard, associate professor of civil engineering, Brown University, was elected member of the sectional committee for five years. The secretary was elected press-secretary for the meeting.

At the meeting of the general committee on January 2, 1908, on the recommendation of the sectional committee, Dr. George F. Swain, professor of civil engineering, Massachusetts Institute of Technology, was elected vice-president and chairman of the section for the ensuing year; and Mr. George W. Bissell, dean of engineering and professor of mechanical engineering, Michigan Agricultural College, was elected secretary for the next five years.

The first paper on the program was one by Arthur H. Blanchard, associate professor of civil engineering, Brown University, and was descriptive of the "Experi-

ments with Tar and Oil on the Highways of Rhode Island.'' It divided highways into three classes, interstate trunk lines and popular routes of travel, highways connecting towns which are only a few miles apart and secondary streets of towns, and third, feeders leading to towns and highways of the two preceding classes and those connecting towns which are many miles apart.

The objects of the experiments with tar and oil have been to reduce to a minimum the amount of dust raised by motor-cars, preserve the surface of the road, and to increase its life. The total cost per square yard of tar-macadam on the Post Road between New York and Boston, and in the Town of Charlestown, in 1906 and 1907, was $0.1624. The amount of tar used per square yard was 1.15 gallons. It was found that the different samples of tar and oil used had compositions which were decidedly different.

Judging from the results of the experiments so far made, it is evident that additional experimental work should be done (1) to determine the relation of the composition of tar to the efficiency of a tar-macadam road and tar-painting; (2) to compare the efficiencies of tar-macadam roads constructed by the mixing and penetration methods; (3) to determine the economic value of scarifying, reshaping and reconstructing the surface of old macadam roads by the addition of tar by the penetration method; (4) to discover methods of increasing the bond between the tar-matrix and the surface of the old material of the road; (5) to determine the efficiencies of the various machines on the market for spreading tar and for making the roads; and (6) the efficiencies of the roads treated with the various oils on the market, and in different ways. The author firmly believes that more stress should be laid on the economic construction of more permanent macadam roads and that less attention should be paid to the various surface palliatives. The paper was published in the *Engineering Record* for February 8, 1908.

The subject of the ''Pressure-Temperature Diagram of the Properties of Superheated Steam'' was discussed and illustrated by Henry T. Eddy, professor of mathematics and mechanics, University of Minnesota. He showed that for purposes of both instruction and use the ''P–T'' diagram offered certain advantages over the ''P–V'' diagram which is usually used, and more especially in showing the variations in the specific heat of superheated steam.

A paper descriptive of ''An Instrument for Investigating the Circulation of Water in Water-tube Boilers'' was read by Frank C. Wagner, professor of experimental engineering, Rose Polytechnic Institute, and was discussed at some length by those present who had made similar experiments.

''A Note on the Shearing Stresses in Beams'' was presented by Calvin M. Woodward, professor of mathematics and applied mechanics, Washington University, and discussed by several members.

The same author read a paper on ''The Problem of Power for Airships,'' which was discussed very fully by the members.

An elaborate paper on the ''Classification and Comparison of Hydraulic Turbines as to Performance at Best Speed,'' and illustrated with tables was read by Benjamin F. Groat, professor of mechanics and mathematics, University of Minnesota.

The same author presented a valuable paper on the ''Efficiency of the Screw.'' These two papers add much to the respective subjects and should be put into permanent form for future reference, being too long to be abstracted satisfactorily.

In the absence of the authors, the following papers were read by title: ''The

Use of Arrow-heads in Alternating-Current Vector-Diagrams," by A. S. Langsdorf, professor of electrical engineering, Washington University; "Segregation in Steel Ingots," by Henry M. Howe, professor of metallurgy, Columbia University.

The other sessions of the meeting were held in Cobb Hall in conjunction with Section A, Mathematics, and the Chicago Section of the American Mathematical Society. For the joint sessions, invitations had been sent to teachers of engineering and of mathematics in the engineering colleges and technical schools of the country, and to professional engineers who, it was thought, might be interested in the subject of an engineering-mathematics symposium. As a result, the attendance was large and representative and included about one hundred persons interested on the mathematical side, and over fifty teaching and practising engineers. Twenty-one privately endowed, and twenty state-supported educational institutions were represented.

The promotion of acquaintance and personal knowledge was an important factor in the success of the meeting, which was in large part due to the labors and foresight of Professor H. E. Slaught, of the department of mathematics of the University of Chicago, and Secretary of the Chicago Section of the American Mathematical Society.

A subscription dinner for engineers and mathematicians and their friends brought about one hundred persons together at Hotel Del Prado on Monday evening, December 30. The speakers at the dinner were introduced by E. B. Van Vleck, professor of mathematics, University of Wisconsin, Chairman of the Chicago Section of the American Mathematical Society. They were Calvin M. Woodward, dean of the School of Engineering and Architecture, Washington University, St. Louis, Mo.; Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Co., Pittsburg, Pa.; George F. Swain, professor of civil engineering, Massachusetts Institute of Technology, Boston, Mass.; and Edward V. Huntington, assistant professor of mathematics, Harvard University, Cambridge, Mass.

The first session of the engineering-mathematics symposium was held on Monday afternoon, December 30. Professor Van Vleck acted as chairman. Four papers were presented, as follows:

The Present Condition of Mathematical Instruction for Engineers in American Colleges: EDGAR J. TOWNSEND, professor of mathematics, University of Illinois.

The Teaching of Mathematics to Engineering Students in Foreign Countries: ALEXANDER ZIWET, professor of mathematics, University of Michigan.

The Teaching of Mathematics for Engineers: CHARLES F. SCOTT, consulting engineer, Westinghouse Electric and Manufacturing Co.

The Point of View in Teaching Engineering-Mathematics: ROBERT S. WOODWARD, president of the Carnegie Institution of Washington.

The two sessions, held on the morning and afternoon of December 31, were devoted to a symposium on the question: "What is needed in the Teaching of Mathematics to Students of Engineering? (*a*) Range of Subjects; (*b*) Extent in the Various Subjects; (*c*) Methods of Preparation; (*d*) Chief Aims." The speakers represented three phases of the subject, namely: (*a*) From the standpoint of the practising engineer; (*b*) from the standpoint of the professor of engineering; (*c*) from the standpoint of the professor of mathematics in the engineering college.

Professor Landreth and Professor Slaught were the chairmen of the two sessions. The speakers were as follows:

Ralph Modjeski, consulting engineer, Chicago, Ill.; J. A. L. Waddell, consulting bridge engineer, Kansas City, Mo.; Gardner S. Williams, professor of civil, hydraulic, and sanitary engineering, University of Michigan; Arthur N. Talbot, professor of municipal and sanitary engineering, University of Illinois; George F. Swain, professor of civil engineering, Massachusetts Institute of Technology; Charles S. Slichter, consulting engineer, U. S. Reclamation Service, and professor of applied mathematics, University of Wisconsin; Frederick S. Woods, professor of mathematics, Massachusetts Institute of Technology; and Fred W. McNair, president of the Michigan College of Mines.

Following the presentation of the four formal papers, and of the eight prepared discussions above recorded, a general discussion was held on the entire subject. The following persons took part in this general discussion: Calvin M. Woodward, professor of mathematics and applied mechanics, Washington University; Benjamin F. Groat, professor of mechanics and mathematics, School of Mines, University of Minnesota; Charles S. Howe, president, Case School of Applied Science; Clarence A. Waldo, professor of mathematics, Purdue University; Clarke B. Williams, professor of mathematics, Kalamazoo College; J. Burkitt Webb, late professor of mathematics and mechanics, Stevens Institute; Henry T. Eddy, professor of mathematics and mechanics, College of Engineering, University of Minnesota; Arthur E. Haynes, professor of engineering-mathematics, University of Minnesota; Arthur S. Hathaway, professor of mathematics, Rose Polytechnic Institute; Edward V. Huntington, assistant professor of mathematics, Harvard University; and Donald F. Campbell, professor of mathematics, Armour Institute of Technology.

On motion of Professor Campbell, the chairman was authorized to appoint a committee of three persons, they to increase their number to fifteen, to be chosen from among teachers of mathematics and engineering and from the practising engineers of the country, and this committee of fifteen was authorized by the meeting to take into consideration the whole subject of the mathematical curriculum in the engineering and technical departments of colleges and universities, and to report to the Chicago Section of the American Mathematical Society. On motion of Wm. T. Magruder, ex-secretary of the Society for the Promotion of Engineering Education and professor of mechanical engineering, Ohio State University, the motion was amended that the committee of fifteen shall submit its report to the Society for the Promotion of Engineering Education at its annual meeting in the summer of 1909. The motion as amended was unanimously adopted by those present. It is hoped that at the meeting of the society in 1909, a second engineering-mathematics symposium may be held.

The selection of this important committee was entrusted to Professor Edward V. Huntington, Harvard University, Professor Gardner S. Williams, University of Michigan, and Professor Edgar J. R. Townsend, University of Illinois. They will select the remaining members of the committee, choose a chairman and secretary, and determine the scope of the investigation that they will make.

The papers will be printed in SCIENCE in the next few weeks. They will prove to be interesting reading to those engaged in either mathematical or engineering work and will show the tendencies of the thought of the meeting. The key-note of all the discussions was that we need more sympathy and knowledge of the ideals, aims and work of the other fellow.

The meeting was without doubt the best

attended that the sections have held for many years, the interest never seemed to flag and, while no wonderful contributions were made to scientific knowledge, every one went away feeling either that he had gained much information as to the other man's point of view concerning scientifically instructing engineering students in mathematics and of the wishes and needs of the engineering instructor, or that he appreciated more the quality of work that was now being done by teachers of mathematics in engineering colleges.

WM. T. MAGRUDER,
Secretary, Section D

PRESENT CONDITION OF MATHEMATICAL INSTRUCTION FOR ENGINEERS IN AMERICAN COLLEGES[1]

OUR country has witnessed in recent years a most marvelous industrial expansion and development. Along with this movement has come a rapidly increasing demand for trained men, equipped with all that science can contribute, to direct and carry forward this development of our natural resources and our industrial power. In meeting this demand our technical schools have experienced a remarkable growth, and not a little of the educational thought and activity of the country is being directed toward the problems connected with technical instruction. Well-equipped engineering schools have grown up in the larger centers of population and most of the larger state universities now include strong engineering departments. Mathematics is so fundamental to all of this work, and so large a proportion of the students now receiving mathematical instruction in this country anticipate making use of it later in connection with engineering work, that it has been thought best by the Chicago Section of the American Mathematical Society to invite to a joint discussion of the "Mathematical Training of Engineering Students," representatives from some of the leading engineering schools and some of those consulting engineers whose wide experience has brought them into contact with demands of actual practise.

That we may all know what the actual conditions are with respect to this instruction and consequently have some common basis for our discussion and our conclusions, I have been asked to present a statement of the work in mathematics which is now being given to engineering students.

As the basis of our consideration, I have selected seventeen institutions where engineering work is an important feature. Of these, eight give their attention largely or exclusively to technical work, and the remaining institutions have strong engineering departments; so that the mathematical work given in these institutions may be said to fairly represent the preparation in this subject for engineering students in American institutions.

The three most important factors entering into the consideration of our topic are: the entrance requirements, the requirements for graduation, and the qualifications of the instructional force.

As will be seen from Table I., all of these seventeen institutions require for entrance algebra through quadratics, together with plane and solid geometry. Five of the institutions require plane trigonometry, while at several others it may be counted for entrance if the student so elects. It will be observed that four institutions require elementary algebra through progressions, four require the subject of logarithms, and two, Sheffield and Cornell, require the whole of college algebra.

[1] Opening address before the joint meeting of Sections A and D of the American Association for the Advancement of Science with the Chicago Section of the American Mathematical Society for the discussion of the topic "Mathematical Training for Engineers."

TABLE I

	Armour	Case	Cornell	Illinois	Lehigh	Mass. Institute	Michigan	Minnesota	Missouri	Nebraska	Purdue	Rensselaer	Rose	Sheffield	Stevens	Wisconsin	Worcester
Algebra.....	p. L.	q	Coll. Alg.	q	Adv. Alg.	p	q	p	q. L.	L	q	p	q	Coll. Alg.	p	p. L.	p
Plane Geometry	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Solid Geometry	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Plane Trigonometry.....	"		"		"		"		e	e				"	"	e	
Spherical trigonometry.....			"														

p = through progressions, q = through quadratics, L = logarithms, e = elective.

There is a general tendency over the country to increase rather than diminish the entrance requirements in mathematics. Several institutions have recently done so, and at a number of others there is a feeling that both trigonometry and college algebra should be required. This disposition to increase the entrance requirements has come about not so much because of a feeling that these subjects can be as well or better taught in the secondary schools, but because of a feeling on the part of the technical schools that the entrance requirements should be made as high as possible in order to give room in the curriculum for those professional and technical branches which are now deemed essential. It may well be questioned whether we are not in some danger of going too far in increasing the requirements. I am sure that we should all agree that the guiding principles should be the limitations of the secondary school program and the ability of the pupil at that stage of his maturity to readily grasp in a comprehensive manner the subjects presented. For example, the advisability of adding college algebra to the entrance requirements is certainly open to the objection that portions of it are clearly beyond the maturity of the average high school pupil, and the introduction of plane trigonometry would seem inadvisable in the average high school on the accredited list of the state universities of the Mississippi Valley. When either of the fundamental principles mentioned is violated, we shall have coming to our freshman class, students with a decided and a justifiable dislike for anything mathematical. Rather than to encounter this danger, it would be far better to extend the engineering course over five years or to require a year of college work in science and mathematics before the student enters upon his technical course. In this connection, it is interesting to note that the University of Minnesota has recently extended its course to five years for students in civil, mechanical and electrical engineering, distributing the required work in mathematics throughout the first four years.

The writer does not share with some the feeling that a greater uniformity in entrance requirements is either desirable or of any particular consequence. Each institution, and especially the state institutions, must take into consideration what the secondary schools contributary to it can do satisfactorily and then shape its

work accordingly. The size of the city, the general interest in educational affairs, the trend which local interests give to the public-school curriculum, all tend to make it possible to accomplish in one community, or in one section of the country, what would be quite impossible in another. We must accept our students with such preparation as our normal constituency can give, stimulated, to be sure, and to a certain extent guided by the higher institution of learning, and build our technical courses upon that preparation as best we may.

More general dissatisfaction is expressed with reference to the preparation of our students in algebra than in any other subject. This comes from both eastern and western institutions as well as from those of the Mississippi Valley. At the University of Illinois last year forty per cent. of the freshman class failed to pass a quiz covering the main points of elementary algebra and that after a two weeks' review of the subject, and twenty-three per cent. of the class failed on a second examination some weeks later. Of the one hundred and ninety students who failed on the first test, seventy-four per cent. entered the university without conditions from schools where the work had been examined and approved by the high-school visitor. The poor results which we get in algebra are not due, in my estimation, exclusively to poor instruction in the subject or to the lack of attention in the high school. It is the one subject in mathematics which is begun in the high school and completed in the college course. Often the high-school algebra is completed in the sophomore year and then not taken up again until the student enters upon his technical course. All know how difficult it is to retain the details of any course of study during an interval of several years in which the subject has been but little used. That this lapse of time between the completion of the high-school work and the beginning of the college work is an important element in the case is shown by the fact that of the one hundred and ninety failures mentioned over fifty per cent. had not had algebra for at least four years, and only ten per cent. had studied the subject the year before.

A substantial gain would be made if we should urge upon the high schools the desirability of putting the last half year devoted to algebra in the senior year of the high-school curriculum and include in that work the more difficult parts of the subject as well as a general review of the parts presented earlier. This arrangement has become quite common in Illinois, and the best argument that can be presented in favor of such an arrangement is that of the one hundred and ninety cases of failure cited over sixty-three per cent. had completed the work in the sophomore year and less than eight per cent. had had any work in algebra in the senior year. Similar records have been kept at Illinois for the past seven or eight years and the data given are typical of the other years.

Unfortunately, we can have no assurance that when a student has once mastered a subject, he will forever afterwards retain it. Neither can we hope that algebra will ever be anything other than the weakest place in the preparation of our students so long as the present division of the subject so largely prevails. It is a situation which we must accept, and the only thing we can do is to make such recommendations as will tend to reduce the number of fatalities as the boy passes from his secondary school to his technical course. The technical school must expect to commence its course in college algebra by a brief review of the important points covered in the high school, by taking a back-stitch, so to speak, into the work already done. Most of the western schools admit by cer-

tificate to the freshman class, and when a pupil is once graduated from an accredited school, he has earned the right to commence upon his technical course. At the University of Illinois, the problem has been solved by saying to the freshmen in mathematics that while there is no disposition to deprive them of their entrance credit, the department of mathematics may nevertheless determine the conditions under which credit in college algebra can be secured. Accordingly, those students who fail to pass the review quiz are required to take two additional hours per week in the subject for the remainder of the semester in order to earn the same credit that is given to others at the close of the course. This has the advantage of placing all of the students practically upon the same basis, so far as attainments in algebra are concerned, when they enter upon the second semester's work.

A somewhat similar plan as that outlined here is followed also at the University of Wisconsin, and perhaps at other institutions. It will be seen from Table I. that a large number of technical schools are now requiring work in logarithms for entrance. This might very well be introduced in connection with theory of exponents and used with advantage in high-school physics. It is also gratifying to observe that the more recent texts on algebra provide work in the use of the graph and in the plotting of curves. It is very desirable that the work in elementary algebra, including the work of curve-plotting, should also include applications to some of the simpler phenomena studied in the high-school course in physics, and this again is made a feature in some of the more recent texts. Such an arrangement affords an additional reason for putting some of the work in algebra late in the high-school course in order that it may follow rather than precede the work in physics, thus making it possible to introduce a wider range of physical applications than could otherwise be done.

In Table II. is shown the number of restrictions given in each of the various mathematical subjects required of engineering students. The average number given to each subject for the seventeen institutions is approximately as follows: college algebra 50, plane trigonometry 46, analytic geometry 80, and calculus 130. In a number of the institutions named, spherical trigonometry is taught by one of the engineering departments, usually the civil-engineering department, in connection with its applications to geodesy. The number of recitations assigned to calculus usually includes also a short course in differential equations. In two cases where a course of more than usual length in the subject is given for the students of a particular engineering department, the subject has been listed separately.[2] One institution, Rose Polytechnic Institute, is unique among strictly engineering schools in offering throughout the four years of undergraduate work a rather large amount of elective mathematics, including short courses in advanced calculus, least squares, projective geometry and quaternions. In all of the universities listed, and at the Massachusetts Institute of Technology the mathematical department offers a rather wide range of advanced subjects, all of which are open to engineering students so far as the demands of their technical course will permit.

By a study of Table II., it will be seen that a considerable difference exists in the amount of attention given to the various subjects. In making comparisons in algebra and trigonometry, however, the difference in entrance conditions must be

[2] Table III. shows the number of recitations given to differential equations in each case when that subject was reported separately.

TABLE II

	Armour	Case	Cornell	Illinois	Lehigh	Mass. Institute*	Michigan	Minnesota	Missouri	Nebraska	Purdue	Rensselaer	Rose	Sheffield	Stevens	Wisconsin	Worcester
Algebra	65	45		55	40 C.E.	30	36	70	36	36	90	55	72 [18]		15	90	64
Plane Trigonometry		60		35		30		45	45	54	70	29	54				45
Spherical Trigonometry		10			22 C.E.	10 C.E.		25	10		20	11	[18]		10		3
Analytic Geometry	55	100	60	90	80 58 C.E.	60	108	110	90	108	72	60	54 [18]	90	69	90	64
Calculus	155	125	120	144	108 96 C.E.	90	144	110	180	126	144	70	180 [72]	100	144	180 160 C.E.	96
Least squares		48 C.E.											[18]				
Vector Analysis																	32 C.E.
Projective Geometry													[18]				
Quaternions													[18]				
Differential Equations		34 M.E.				45 E.E.											

C. E. = civil engineers, M. E. = mechanical engineers, E. E. = electrical engineers, [ ] = elective.

*Massachusetts Institute of Technology now offers a course which combines the instruction in algebra, analytic geometry and calculus rather than teaching these subjects as separate branches. In tables II. and III., the distribution of time formerly given to these subjects is indicated as showing better the relative emphasis placed upon each.

taken into consideration. The amount of work given in algebra ranges from fifteen recitations at Stevens Institute, with an entrance requirement of elementary algebra through progressions, to ninety recitations at Purdue with a requirement of elementary algebra through quadratics for entrance. Likewise the work in plane trigonometry ranges from thirty recitations at the Massachusetts Institute to seventy at Purdue. Analytic geometry and calculus are naturally the most important subjects for engineers in the mathematical curriculum. One would naturally expect to find a greater uniformity here. This, however, is not the case. In analytic geometry, it will be noticed that Armour Institute requires but fifty-five recitations, while the University of Minnesota gives one hundred and ten recitations to the subject. Again in calculus the work varies from seventy recitations at Rensselaer to a maximum of one hundred and eighty at Missouri, Wisconsin and Rose. A word should be said, perhaps, concerning the number of recitations recorded in the case of Rensselaer. The department of mathematics of that institution reports that the recitations are from an hour and a quarter to an hour and a half in length and that the efficiency of the work is still further increased by the fact that but two academic studies are carried simultaneously.

It will be of interest also to compare the total amount of time spent upon mathematics at these various institutions. As will be seen from Table III., this ranges from one hundred and eighty recitations at Cornell to three hundred and ninety-six at Purdue. In making this comparison,

TABLE III

Institution	Freshman	Sophomore	Junior	Senior	Total
Armour.....	Al 65; An 55; C 50	C 85; Diff. eqs. 20			275
Case.	Al 45; Tr 70; An 55	An 45; C 125	Diff. eqs. 34 (E.E.)	Least squares 48 (C.E.)	M.E.; 340 E.E.; 374 C.E.; 388
Cornell.....	An 60; C 120				180
Illinois.....	Al 55; Tr 35; An 90	C 144			324
Lehigh.....	An 80; C 108 Al 40; Tr 22; M 25	(C.E.) An 58; C 96			E.E.; M.E.; 188 C.E.; 241
Mass. Inst..	Al 30; Tr 30; An 60	C 90; Sph Tr 10 (C.E.)	Diff. eqs. 45 (E.E.)		M.E.; 210 E.E.; 255 C.E.; 220
Michigan...	Al 36; An 108	C 126	Diff. eqs. 18		288
Minnesota..	Al 70; Tr 70; An 40	An 70; C 110			360
Missouri....	Al 36; Tr 55; An 90	C 180			360
Nebraska ...	Al 36; Tr 54; An 72; C 18	An 36; C 108			324
Purdue.....	Al 90; Tr 90	An 72; C 72	C 72		396
Rensselaer..	Al 45; Tr 40; An 39	An 21; C 70			225
Rose	Al 72; Tr 54; C 36 [S Tr 18]; [Proj. Geom. 18] [Al 18]	An 54; C 90 [Quat 18] [An 18]	An Dyn 54 (calculus) [C 72] [Least squares 18]		360 [180]
Sheffield	An 90	C 100		[Probs. and computing]	190 [Probs.]
Stevens.....	Log 15; Sph Tr 10; An 43; C 30	An 26; C 86	Diff. eqs. 28		238
Wisconsin..	Al and Tr 90; An 90	C 160; Diff. eqs. 20 (M.E.; E.E.)			M.E.; E.E.; 360 C.E.; 340
Worcester...	Al 64; Tr 48	An 64; C 96	Vect. and 32 (E.E.)		272 E.E.; 304

Al = algebra, An = analytic geometry, C = calculus, Tr = trigonometry, M = mensuration, Quat = quaternions, An Dyn = analytical dynamics, [ ] = elective.

we should again take into consideration the difference in entrance requirements. When this is done, the difference is more apparent than real. For example, if we add to the number of recitations given at Cornell the number of recitations given at Purdue to college algebra and trigonometry, which are required for entrance at Cornell as compared with three hundred and ninety-six at Purdue.

It would seem that the technical schools generally might well afford to make more ample provision for elective mathematics. Such courses as spherical trigonometry, least squares, differential equations, might well be placed in such a list. In this way certain subjects which are desirable for some branches of engineering, but not so essential for others, could be taken by those students interested. Sheffield offers as an elective another course which might be given with advantage at other technical schools, namely, a course in scientific computation in which the use of modern calculating machines of various kinds is explained and made use of. It would also be well if the stronger institutions could go still farther and introduce elective

courses in spherical harmonics, vector analysis, theory of functions and the mathematical theory of heat, electricity, etc., to the end that the student with exceptional mathematical ability might lay a broader foundation for the theoretical side of engineering. In this connection, it may well be questioned whether the technical schools of this country are in general offering sufficient opportunity for that training which has made it possible for such men as Steinmetz, Osborne Reynolds and Stodola to accomplish the work which has made them famous.

Table III. shows also the sequence and the distribution by years of the required work in mathematics. We are quite as much interested, however, in the character as in the amount and distribution of the mathematical instruction given to engineering students. The close observer will have noticed the change which has been made and is now being made in this respect. In recent years there has swept over the country a wave of enthusiastic discussion concerning a closer and better correlation of mathematics with the physical sciences. This has been due for the most part to the influence felt in this country of the Perry movement in England. Much is to be learned from this movement, and still more is to be avoided. The discussions which have arisen from it have on the whole had a beneficial effect upon the teaching of mathematics both in America and in England.

It has first of all led to the introduction into our text-books, and still more generally into our teaching, of a very much better selection of problems—problems which widen the student's fund of information of physical phenomena and apply the mathematical principles which he is acquiring more extensively than was formerly the case to the physical laws with which he is familiar. Such problems as the following, taken from a recent number of an educational journal purporting to serve the interests of mathematical teachers in the secondary schools, is no longer thought to be in good form by our best instructors:

"I bought 674,867 sheep at less than $10 per head; I paid for them in ten-dollar bills and received back in change $7.39. How many bills did I give?"

Need I call attention to the absurdity of putting such problems into the hands of pupils? How many farmers in any wool-producing state of the country ever even saw that many sheep in his entire life, and, should he have occasion to buy them, would for a moment think of paying for them by counting out 663,395 ten-dollar bills. So long as such problems are given out for the consideration of pupils, just so long we may expect even the best of them to ask the question so often heard in our algebra classes: "What is all of this 'stuff' good for, anyway?"

Contrast with this problem the following, taken at random from an algebra recently published:

"Two boys, A and B, having a 30-lb. weight and a teeter board, proceed to determine their respective weights as follows: They find that they balance when B is 6 feet and A 5 feet from the fulcrum. If B places the 30-lb. weight on the board beside him, they balance when B is 4 and A is 5 feet from the fulcrum. How heavy is each boy?"

In solving this problem the boy has learned just as much mathematics as in solving the first. In addition, his mathematics has been brought into contact with a fundamental physical law, and incidentally he is made to feel that, after all, his mathematics is of consequence to him in solving the sort of questions in which he

is interested or is likely to have experience with in the future.

As has been pointed out, a change in the character of the problems is gradually taking place in our mathematical texts. Perhaps a word of caution should be given lest we go too far in the opposite direction, by introducing problems which require a technical knowledge and experience beyond the comprehension of our students. Perry's calculus is a conspicuous illustration of this danger. The subjects discussed in that book would form a good sequel to a certain work in engineering, but the book seems to be hardly suited to meet the needs of American schools as a preparation for engineering study. We should aim to make the mathematical work practical and in harmony with engineering practise, but without making it at the same time technical in its applications, or without going too far afield by teaching mathematical physics.

Another improvement which has recently become noticeable in the teaching of mathematics in this country is the breaking down of the traditional barriers between the different branches and a corresponding closer correlation of the different subjects in the mathematical curriculum. In several of our institutions the sharp division of freshman work into algebra, trigonometry, and analytic geometry is being more or less disregarded and these subjects taught as a single unit. It is thought that the student is thus enabled to grasp more readily these subjects as a whole, and that the instructor can introduce much earlier the principles of analytic geometry and of calculus and postpone to the later part of the course those topics which are relatively difficult and not so essential to the elementary work of the course.

This plan is now being followed somewhat closely at the University of Wisconsin. In the first semester fifteen or twenty recitations are devoted to the elementary portions of trigonometry. This is followed by work in algebra, including the theory of complex numbers, using trigonometry and a large amount of graphic work, and the elementary principles of analytic geometry. In this work trigonometric computation and the use of the slide rule form an important part. In the second semester the algebra and trigonometry are continued and combined with the essentials of analytic geometry.

This correlation of the work of the freshman year seems to have been most thoroughly worked out at the Massachusetts Institute of Technology, where Professors Woods and Bailey have recently prepared a text covering the work given there in the freshman year, excluding, however, trigonometry. The indications are that other institutions are also contemplating a revision and better correlation of the work of the first year.

In some of the recent books, the sharp division of the calculus into differential and integral calculus is done away with, thus making it possible to introduce the student to a wide range of easy applications at an early point in the course and to relegate to its proper place some of the more difficult parts of the differential calculus. There is a tendency also to introduce the methods of the calculus earlier and make them the basis of portions of the analytic geometry. For example, Rose Polytechnic Institute gives a short course of thirty-six recitations in the subject before analytic geometry is taken, and what is accomplished there in this formal way is undertaken at other institutions by introducing into the analytics the elementary notion of derivatives or by teaching the two subjects simultaneously.

While all are agreed that for engineers mechanics should stand in a close and vital relation to the calculus, that in fact it is

the principal reason for teaching calculus, not all are agreed, however, as to the best method of accomplishing this purpose. Some would maintain that it should be taught by the mathematical department and in connection with calculus; others and perhaps the larger number feel that it should be given by the engineering departments and made to follow and supplement the calculus, giving the student his first real introduction into the applications of his mathematics to the fundamental principles underlying all engineering courses. However this may be, there is little doubt that more applications to mechanics should be introduced into the course in calculus than is now usually the case, even to the exclusion, if need be, of some of the applications to geometry frequently given. Problems in work, energy and stress form just as legitimately an integral part of a course in calculus as problems in order of contact, asymptotes or envelopes. The applications to geometry and to mechanics should be given about the same relative importance in a well-balanced course in calculus.

Descriptive geometry is another subject in the engineering course which might well be revised and made more mathematical in its treatment. It is to be regretted that the subject has in this country degenerated into little more than mechanical drawing. It would be greatly improved for engineers, as well as the general student, if we should inject into it something of the scientific spirit given it in European schools.

No presentation of the subject under discussion would be complete without some consideration of the preparation which the teacher of mathematics has, or should have, who is to teach the subject to engineering students. There is a strong feeling in some quarters that such an instructor should be a trained engineer in order that he may the better appreciate the kind of applications which are best suited to the training of an engineer and to make sure that the proper emphasis be placed upon those topics considered essential in such training. Some would go still farther and insist that even in the elementary courses in mathematics usually given in the first two years, the purpose and aim of the prospective engineer is so radically different from that of the general student that the content of the course itself should be very different from what is best suited to the student who elects mathematics as a part in a general education.

It goes without saying that we should eliminate from the courses for engineering students that which is non-essential, and we should make them as practical as we may by the generous use of those physical applications which will give the students both skill and facility in applying mathematics to such concrete cases as may arise later in his experience. On the other hand, it would be disastrous to go to the extent of teaching any of the principles of mathematics empirically or of permitting students to assume as already established formulas which he has merely to learn how to apply. We should avoid the danger of going too far in allowing the student to disregard the necessity of a formal demonstration and to regard lightly the logic and the philosophy of mathematics. What is needed first of all is the ability on the part of the student to think mathematically and to have not only a ready but an intelligent command of the fundamental principles of the subject. We should introduce the applications of mathematics not for the sole purpose of giving the student a foretaste of the things which are in store for him, but because such applications give him additional opportunity for gaining a clearer comprehension of mathematical processes and principles which might otherwise be hazy; and I wish to add that this is more

essential for the sound training of the special student of mathematics with his limited opportunity for the application of his subject to physical phenomena than it is for the engineering student who in the future is to have opened up to him that wide range of applications which his technical studies provide. In other words, what is essential in the way of applications for the engineering student in the first two years of his mathematical work gives the very best training for the student who is taking mathematics as an element in a liberal education. The proper place for differentiation, so far as the content of the course is concerned, would seem to be after the completion of the course in calculus rather than before. I present this as a plea for the general student, that he should have more of the applications of his mathematics rather than that the engineering student should have less. Both should have thorough drill in the fundamental principles of the subject and in addition all of the applications of those principles which their limited experience and knowledge of physical phenomena will permit. No student, enginering or otherwise, should be led to regard his mathematical work in the same light in which a carpenter may properly regard his jack-plane, a mere tool with which to accomplish certain results; neither should the instructor teach mathematics in the spirit in which a skilled operator might regard a finely-equipped machine shop whose sole purpose is to make more machines. Both extremes are to be avoided in the early courses in mathematics. The opportunity for specialization and differentiation should come later; and any student who is not capable of grasping the fundamental principles of the mathematics usually required in an engineering course should not aspire to a bachelor's degree from a large university or technical school.

What training is essential or desirable, then, on the part of the mathematical instructor of engineering students to best accomplish the general results here set forth? There is no doubt that the ideal thing would be to take men who have completed an engineering course and later supplemented it by special work in mathematics. This, however, does not seem feasible because of the few who could be induced to take such a course of training. It would be quite impossible to induce a sufficient number of engineers to take up the teaching of mathematics to meet the demand, even if that seemed desirable. In most cases the boy enters the engineering course with the view of practising his profession when he has completed the course. As a rule he has little taste or inclination for teaching, and those few who can be induced to enter the less remunerative profession of teaching are absorbed, as indeed they should be, by the engineering departments of our technical schools. To put an engineering graduate at teaching mathematics without first having had special training in mathematics would be wholly undesirable. Such an instructor knows but little about pure mathematics beyond the elementary courses which he is presenting, and, what is even worse, often has but little interest. If he can be induced to take up in a serious way the study of mathematics, he is in a fair way of becoming a good teacher of the subject. I am thoroughly convinced that mathematics should be taught by mathematicians just as engineering should be taught by trained engineers; but the mathematical instructor who wishes to teach engineers should be familiar with the general field of applied mathematics—mechanics, strength of materials, thermodynamics, and in addition so much of the broader field of mathematical physics as possible.

While the mathematical instructor should have some knowledge of its applications, it

is equally desirable that the teacher of engineering should from time to time both refresh and revise his knowledge of the fundamental things in mathematics, to the end that he may keep his methods up to date and adapt his teaching to the kind of mathematical instruction which his students have had and avoid those methods and those forms of expression which have long been out of use.

In closing, I wish to add that the rapid increase in engineering students has so greatly increased the demand for mathematical instructors having some knowledge of engineering that it would be highly desirable if more attention should be paid to the preparation of men for such positions. This can best be accomplished, perhaps, in those universities having large engineering departments by a closer correlating of the work of the mathematical department with theoretical work in engineering and mathematical physics. It is to be regretted that so little attention in this country is now being given to these two fields of mathematical activity. Institutions so situated as to undertake it should offer to its students graduate work in these lines in every respect worthy of a doctor's degree, and likewise to its instructors both opportunity and encouragement to do research work in this broad and fruitful field of human endeavor.

EDGAR J. TOWNSEND
UNIVERSITY OF ILLINOIS

INTERNATIONAL FISHERY CONGRESS, 1908

THE Fourth International Fishery Congress will convene in the city of Washington, United States of America, from the twenty-second to the twenty-sixth of September, 1908, to deliberate on important matters relating to fishing and fish culture and to submit propositions for the benefit of the fisheries to governments and to state, provincial and local authorities.

The congress will be organized and conducted in conformity with the decisions for the regulation of the international fishery congresses decreed in Paris in 1900.

The membership of the congress will consist of government, state, and provincial representatives, delegates from home and foreign societies, corporations and persons invited by the management of the congress, and persons at home and abroad who are deemed to have an interest in the purposes of the congress and express a wish to take part in it.

All members have the right to vote, to participate in the discussions, and to make independent propositions. In case a corporation should be represented by several delegates, the members of this delegation have the right to only one vote, which shall be cast by the delegate designated to the presiding officer. The delivery of the card of admission gives to members the right to take part in all the enterprises and excursions projected by the congress, to receive all the publications, and to wear the insignia of the congress. The members of the congress are required to conform to its regulations and decisions.

The membership fee is fixed at $2 for each person, excepting the official representatives of governments, who become members by virtue of their credentials.

In response to invitations extended by the government of the United States, twelve national governments have already signified their purpose to be officially represented, and delegates have been appointed by the governors of many of the states of the United States. In view of the small number of the nations which have formally indicated their inability to officially participate and the large number of persons who will attend as individuals or as representatives of important fishery societies, the congress promises to be important in its representative character, size, and the value of its proceedings.

All persons interested in the fisheries, fish culture, and fishery administration, or in scientific investigations and experiments related to the fisheries are invited to attend the meetings and take part in the discussions. To

those who can not attend the meetings of the congress an invitation is extended to submit papers on subjects relating to the fisheries, mailing them to the secretary-general of the congress in season to reach him prior to the opening meetings. For the guidance of those desiring to participate in this manner, the following scheme of subjects is submitted, but the papers need not be restricted to the titles suggested:

1. *Commercial Fisheries:*
   (*a*) Apparatus and methods of fishing.
   (*b*) Vessels and boats.
   (*c*) Handling, preparing and preserving the catch.
   (*d*) Utilization of neglected and waste products.
2. *Matters affecting the Fishermen and the Fishing Population:*
   (*a*) Hygiene of vessels and houses of fishermen.
   (*b*) Diseases of fishermen and their families.
   (*c*) Means for preventing loss of life at sea.
   (*d*) Technical education in fishing, fish handling, and fish culture.
   (*e*) Fishery schools.
3. *Legislation and Regulation relative to:*
   (*a*) Fishing.
   (*b*) Fish culture.
   (*c*) Pollution of waters.
   (*d*) Obstruction of waters.
4. *International Matters affecting the Fisheries:*
   (*a*) Regulation and legislation.
   (*b*) Research.
   (*c*) Statistics.
5. *Aquiculture:*
   (*a*) Fresh-water fishes.
   (*b*) Salt-water fishes.
   (*c*) Frogs, turtles, and terrapins.
   (*d*) Oysters and other mollusks.
   (*e*) Lobsters, crabs, crayfish and other crustaceans.
   (*f*) Sponges.
   (*g*) Algæ and other plants.
   (*h*) New appliances and methods.
   (*i*) Utility of fish culture in the ocean and in large inland waters.
6. *Acclimatization:*
   (*a*) American fishes abroad.
   (*b*) Foreign fishes in America.
   (*c*) Introduction of other foreign species.
7. *Fishways and Fish Ladders.*
8. *Biological Investigation of the Waters and Their Inhabitants:*
   (*a*) Methods and appliances.
   (*b*) Results.
9. *Diseases and Parasites of Fishes, Crustaceans, Mollusks, and Other Water Animals.*
10. *Angling and Sport Fishing.*

During the week following the regular sessions of the congress, special meetings will be arranged in New York, Boston, Gloucester and possibly other places in New England, it being the purpose to bring the members together for informal sessions in those places, and at the same time to provide time and opportunity for them to visit localities in which they may have a personal interest. In connection with these meetings arrangements will be made to exhibit to the members the methods of the American sea fisheries and the greatest of the fishery ports and fish markets of the United States.

Other places which may be visited, but for which no special arrangements will be made, are Baltimore, the center of the great oyster industry of Chesapeake Bay, which lies within forty miles of Washington; and Chicago and other lake ports, where the fishery trade and methods of the Great Lakes, the most valuable fresh-water fisheries in the world, may be studied.

Suitable arrangements will be made for the entertainment and instruction of the members in Washington and at the other places visited, and an opportunity will be given for visits to places of general interest.

During the week beginning September 20 the headquarters of the congress will be established in the New Willard Hotel, Washington, D. C., where information relating to hotel accommodations, transportation, places of interest, and other matters will be available. All communications and inquiries before that date should be addressed to the Secretary-

General of the Congress, Bureau of Fisheries, Washington, D. C.

THE AMERICAN CHEMICAL SOCIETY

THE thirty-eighth general meeting of the American Chemical Society was held in New Haven, Conn., June 29 to July 2, and was one of the most successful summer meetings ever held by the society. Two hundred and fifty members were present and one hundred and seventy-four papers were presented.

The large number of papers made it necessary to hold more sectional meetings than usual and the society met in six sections for the presentation of papers.

The society met in the lecture rooms of the Sheffield Scientific School and the following nine papers were presented in general session before all the members: "Official Inspection of Commodities," by A. L. Winton, chairman of the Agricultural and Food Section; "The Increasing Importance of the Rarer Elements," by P. E. Browning, chairman of the Inorganic Section; "The Analyst, the Chemist and the Chemical Engineer," by Wm. D. Richardson, chairman of the Industrial Section; "A Discussion of Some of the Methods used in Determining the Structure of Organic Compounds," by Wm. McPherson, chairman of the Organic Section; "Our Present Knowledge of Plant Proteins," by T. B. Osborne, chairman of the Biological and Sanitary Chemistry Section; "Some Applications of Physical Chemistry," by Frank K. Cameron, chairman of the Physical Chemistry Section; "Chemical Publications in America in Relation to Chemical Industry," by W. A. Noyes; "The Electrolytic Theory of the Corrosion of Iron as applied to the Protection of Steam Boilers," by W. H. Walker; "The Research Chemist," by W. R. Whitney.

On Wednesday afternoon, July 1, an excursion to Ansonia was enjoyed by the visiting chemists for the purpose of visiting the works of the Ansonia Brass and Copper Company and the Coe Brass Manufacturing Company. On the evening of the same day the members met on the East Shore for a social outing and dinner.

The organization of the Division of Industrial Chemists and Chemical Engineers was a feature of the meeting and the following officers were elected: *Chairman,* A. D. Little; *Vice-chairman,* A. H. Low; *Secretary,* B. T. B. Hyde; *Executive Committee,* Wm. H. Walker, Wm. Brady, J. D. Pennock, W. C. Ebaugh, F. B. Carpenter. Twenty-eight important papers were presented before the division and marked enthusiasm was shown. A movement is also on foot for organizing the food chemists, the general and physical chemists and the fertilizer chemists.

The rapid growth of the society under the impetus of the organization of chemists into special groups and the continually improving quality of its journals was noted by all, seven hundred new members having been added in the last eight months.

Matters of decided importance were brought before the council and acted upon. A new section of the society was established with headquarters at Louisville, Ky. It was decided that the winter meeting should be held in Baltimore in affiliation with the American Association for the Advancement of Science and that the summer meeting for 1909 should be held in San Francisco.

The society having been represented by its president in the recent conference in Washington on the Conservation of our Natural Resources, it was voted that a standing committee on the conservation of our natural resources be established and that the American Chemical Society should attempt to point out how chemists could assist this movement.

W. D. Richardson was elected editor-in-chief of the new *Journal of Industrial and Engineering Chemistry* and the following were elected as associate editors: Henry M. Howe (metallurgy of iron and steel), A. H. Low (metallurgy of gold, silver and lead), Geo. C. Stone (copper, zinc and other non-ferrous metallurgy), Willis R. Whitney (applied electrochemistry), F. W. Lovejoy (photochemistry), A. E. Leach (foods), L. P. Kinnicutt (water, sewage and sanitation), F. B. Carpenter (fertilizers and soils), Robert Wahl (fermented and distilled liquors), Virgil Coblentz (pharmaceutical chemistry), T. J.

Parker (heavy chemicals), J. B. F. Herreshoff (sulfuric acid), Karl Langenbeck (ceramics), G. E. Barton (glass), Ernest B. McCready (cement, mortar and building materials), Clifford Richardson (asphalt and petroleum), A. D. Little (cellulose and paper), Francis I. du Pont (explosives), E. G. Bailey (fuels), J. D. Pennock (destructive distillation), John Alden (textiles, bleaching and dyeing), P. C. McIlhiney (pigments, resins and varnish), W. C. Geer (rubber), Ernest Twitchell (fats, waxes and soaps), W. D. Horne (sugar and starch), W. K. Alsop (leather), G. R. Underwood (glue), Edward Mallinckrodt (fine chemicals), M. C. Whitaker (gas), W. F. Hillebrand (pure and analytical chemistry), W. H. Walker (engineering chemistry), Wm. Campbell (metallography), W. C. Ebaugh and F. H. Thorp (miscellaneous industrial chemistry).

The Committee on the Qualifications of Chemists made a preliminary report on the establishment of an Institute of Chemistry, which has been under consideration for the past two years and it was decided on account of its great and far-reaching importance to refer this matter again to a representative committee of fifteen for further consideration to report back to the council.

The committee appointed to consider the training and education of chemists and chemical engineers made its report and as a result a movement is under way to establish a Section or Division of Chemical Education within the society, which shall especially appeal to teachers and shall study more particularly the existing standards and methods of instruction throughout the country and the possibility of improving them.

The society adjourned after one of the pleasantest meetings in its history.

SCIENTIFIC NOTES AND NEWS

The medal struck by the Linnean Society to commemorate the fiftieth anniversary of the reading of the papers on natural selection by Darwin and Wallace was, on July 1, awarded to Dr. Alfred Russel Wallace, Sir Joseph Dalton Hooker, Professor Ernst Haeckel, Professor Eduard Strasburger, Professor August Weismann, Dr. Francis Galton and Sir E. Ray Lankester.

On the occasion of King Edward's birthday, baronetcies were given to Sir T. Lauder Brunton, F.R.S., and Dr. W. W. Cheyne, F.R.S., and the knighthood to Professor A. G. Greenhill, F.R.S., and Colonel David Bruce, F.R.S.

M. Henri Becquerel has been elected permanent secretary of the Paris Academy of Sciences for the physical sciences.

Dr. William Osler, regius professor of medicine at Oxford, has been selected as an independent candidate for the lord rectorship of Edinburgh University.

At the eighty-third annual commencement of Hobart College the address before the Phi Beta Kappa Society was delivered by Professor A. G. Webster, of Clark University, who received the honorary degree of LL.D.

Dr. William J. Holland, director of the Carnegie Museum, has returned from his visit to Germany and France to present on behalf of Mr. Andrew Carnegie life-size plaster casts of the Diplodocus. In recognition of his services to science, the German emperor conferred upon Dr. Holland the Order of the Crown, while President Fallières bestowed upon him the Cross of the Legion of Honor.

The Rumford Committee of the American Academy has made the following grants in aid of researches in light and heat: To Professor N. A. Kent, of Boston University, an additional appropriation of $400 for a set of echelon plates for use in his research on the conditions influencing electric spark lines. To Professor Joel Stebbins, of the University of Illinois, an additional appropriation of $100 for his research on the use of selenium in stellar photometry.

A gold medal was recently struck and presented to Professor Ramón y Cajal, in the name of his friends and admirers throughout Spain. Professor Cajal refused to permit a public ceremony, and the medal was presented informally at his home on May 27.

PROFESSOR H. H. TURNER, F.R.S., has been elected correspondent of the Paris Academy of Sciences in the section of astronomy.

THE prize of £50 of the Gordon-Wigan fund, Cambridge University, for a research in chemistry has been awarded to Mr. L. A. Levy for his research entitled "Investigations on the fluorescence of platinocyanides."

DR. O. HOFFMAN-BANG, director of the Copenhagen Agricultural Experiment Station, Denmark, is visiting the stations in this country.

DR. BERTRAM H. BUXTON, professor of pathology in the Medical College and director of the department of experimental pathology of Cornell University, is on his way to London, where he will remain until September.

THE *Roosevelt,* Commander Peary's Arctic exploring ship, left the pier at East Twenty-fourth Street, New York City, on the afternoon of July 6. Commander Peary, his crew and invited guests, including members of the Arctic Club, were on board the vessel, which was convoyed by a government tug to City Island, whence it proceeded to Oyster Bay, where President Roosevelt inspected it.

NEWS has been received to the effect that Dr. Sven Hedin, the Swedish explorer, left Gartok, a town in Tibet, on the headwaters of the Indus, early in November of last year, with the intention of spending the winter at Khotan, in Chinese Turkestan. He planned to return to Leh, in the valley of the Indus, this summer.

COLONEL DAVID BRUCE, who will be in charge of the new commission to proceed to East Africa to investigate the sleeping sickness, will be accompanied by Captain A. E. Hamerton.

DR. GUILLERMO PATTERSON, JR., has resigned an assistantship in pathological and physiological chemistry in Cornell University, and is on his way to the Isthmus of Panama, where he will collect samples of medicinal herbs for analysis and will continue his studies on local climatology. His address will be: Apartado No. 116, Panama City.

MR. HERBERT J. SPINDEN, of the Peabody Museum, Harvard University, has been commissioned by the American Museum of Natural History to spend the summer among the Nez Percé Indians and other tribes speaking dialects of the same linguistic stock, for the purpose of securing data on such phases of their culture as he has not previously investigated. The museum has received permission from the U. S. government to send the Rev. G. L. Wilson to Fort Berthold Reservation, North Dakota, in order that he may procure additional information regarding the traditions and tribal history of the Mandan Indians.

PROFESSOR W. M. DAVIS's summer school of geology has opened successfully. He has studying under him foreign as well as American students. By the time he reaches Grenoble in July he will have at least fifteen in his party.

THE executive board of the International Botanical Society has appointed Edward W. Berry, of the Johns Hopkins University, American editor for paleobotany of the *Botanisches Centralblatt.*

THE following are among the pensions which were granted during the year ended March 31, 1908 (amounting in all to £1,200), and which are payable under the provisions of the British Civil List: Sir Edwin Ray Lankester, K.C.B., £250, in consideration of his eminent services to science; Dr. John Hall Edwards, £120, in recognition of his devotion to the furtherance of radiography in its application of medical and surgical science; Mrs. Sarah Elizabeth Tichborne, £60, in consideration of the useful discoveries of her husband, the late Dr. C. R. C. Tichborne, in chemistry and pharmacology, and of her inadequate means of support; Mrs. Theodora Copeland, £60, in recognition of the services rendered to astronomical science by her husband, the late Dr. Ralph Copeland, and of her inadequate means of support; Mrs. Jessie Wilhelmina Blyth, £60, in consideration of the eminent attainments of her husband, the late Professor James Blyth, in physical science.

WE learn from *Nature* that a monument to the memory of Boucher de Perthes was unveiled at Abbeville on June 8. Boucher de

Perthes, who made important discoveries in prehistoric anthropology in the neighborhood of Abbeville, died there in 1868. In 1832 he found at Thuison, near Abbeville, the first stone engravings, and in 1863, in the Moulin Quignon cave, the remains of Quaternary man with flint axes. The collections made by Boucher de Perthes were bequeathed to the state, and are preserved in the Museum of Saint-Germain-en-Laye.

W. R. Cassie, professor of physics at the Royal Holloway College for Women and secretary of the Physical Society, died on June 22, aged forty-seven years.

Mr. George Sim, the Scottish naturalist, died at Aberdeen on June 15, at the age of seventy-three years.

The annual visitation of the Greenwich Royal Observatory took place on June 3, the board of visitors being constituted as follows: Lord Rayleigh, Mr. H. F. Newall, Professor W. G. Adams, Professor J. Larmor, Professor Sir J. Norman Lockyer, Lord Rosse, Principal Sir A. W. Rücker, Captain Sir W. de W. Abney, Professor Sir R. S. Ball, Professor R. B. Clifton, Dr. J. W. L. Glaisher, Sir W. Huggins, Mr. E. B. Knobel, Professor H. H. Turner, Professor Sir G. H. Darwin, Rear Admiral A. Mostyn Field (hydrographer of the navy) and Mr. W. D. Barber (secretary). A large number of gentlemen interested in astronomy were present by invitation of the astronomer royal, and took part in the inspection of the observatory and instruments.

We learn from the London *Times* that the proposals for the formation of a new institute on the lines of the Iron and Steel Institute in connection with the nonferrous metals are taking definite shape. A further meeting was held in London on June 10, and it is understood that the movement has the cooperation and approval not only of copper smelters, copper wire drawers, copper and brass founders and other metal manufacturers, but also of boiler makers and marine engineers. The leading firms of shipbuilders have also announced their intention of supporting the proposed institute, and of course shipbuilders are among the largest consumers of brass and copper. The new institute is to be founded on an international basis, and it is stated that the manufacturers and metallurgists in France, Germany, Sweden, the United States, and other countries have announced their intention of supporting the proposed society.

There will be held in Berlin from October 3 to 18, inclusive, 1908, an exhibition under the auspices of the Brewers' College and Institute for Experimental Research on the occasion of its twenty-fifth anniversary. The management of the exhibition is undertaken by Professor M. Delbruck and Professor E. Struve. The offices are in the Institute for Brewing and Allied Trades, Seestrasse, Berlin N. 65. A copy of the regulations governing this international exhibition may be had by addressing Dr. Harvey W. Wiley, Washington, D. C., also an entry form for a description of samples of hops and barley which any one may desire to exhibit. Samples of barley should consist of not less than 30 kilograms and of hops 4 kilograms. Prizes will be awarded and a jury will be appointed for that purpose. It is hoped that the growers of hops and barley in this country will take an active part in this exhibit. Full instructions will be found in the regulations referred to above.

An International Congress of Historical Science is to be held this year in Berlin from August 6 to August 12. The work of the congress will be carried on in general and sectional meetings. There are eight sections, as follows: (1) Oriental History; (2) History of Greece and Rome; (3) Political History, medieval and modern; (4) History of Civilization and the History of Thought, medieval and modern; (5) Legal, Social and Economic History; (6) Ecclesiastical History; (7) History of Art; (8) Sciences subsidiary to History (Archives, Libraries, Chronology, Diplomatic, Epigraphy, Genealogy, Historical Geography, Heraldry, Numismatics, Paleography, Study of Seals). At the general meetings lectures will be given by Professor Maspero, Professor Cumont, Sir Frederick Pollock, Sir William M. Ramsay and Professor Monod. Copies of the program can be obtained from the secretary of the congress, Dr. Caspar, Kaiser-Allee 17, Berlin W. 15.

THE Royal medals and other awards given annually by the Royal Geographical Society for the encouragement of geographical science and discovery have, as we learn from *Nature*, been distributed as follows: The founder's medal was presented to Lieutenant Boyd Alexander, for his African explorations and careful trigonometrical survey of the region between the Benue and Lake Chad. Lieutenant Boyd Alexander devoted a considerable time to the exploration of Lake Chad, and added materially to our knowledge of that constantly shifting lake. A careful study was made of the hydrography of the various river systems, the Niger, the Congo and the Nile, through which the expedition has passed. Detailed maps were made of the more unknown parts of the region, such as the Bamingi, Kibali and the Yei rivers. Much information was gathered concerning the physical features of the region passed through; careful studies were made of several of the types of natives, and important additions were made to our knowledge of the natural history of the extensive region. The patron's medal was awarded to H.S.H. the Prince of Monaco, for his work in oceanography. Among the notable additions to scientific knowledge made on board the *Princess Alice* are: (1) the results of using the deep-sea traps invented by the Prince, which threw a new light on the life on the floor of the deepest parts of the ocean; (2) successive seasons' exploration on the coast of Spitzbergen and in the adjacent seas; and (3) studies of the conditions of the upper air by means of meteorological kites in mid-Atlantic. Other awards were as follows: Murchison award to Colonel Delmé-Radcliffe, for his work when as resident in the Nile province of Uganda he mapped the whole province, and for the work which he did afterwards when in charge of the English section of the Anglo-German Boundary Commission, between Victoria Nyanza and Mount Ruwenzori. The Gill memorial to Dr. T. G. Longstaff, for his exploring work in the western Himalayas and Tibet, and especially on his last expedition in the Garhwal Himalayas, when he ascended the summit of Trisul. The Back bequest to Lieutenant George Mulock, for his long-continued work, mostly during his own time, in preparing the six sheets of the Antarctic charts, showing the results of the *Discovery* expedition. The Cuthbert Peek grant to Rai Sahib Ram Singh, a native Indian surveyor, who has done excellent surveying work on the expeditions of Captain Deasy, Dr. Stein, Captain Rawling and Major Ryder.

UNIVERSITY AND EDUCATIONAL NEWS

THE Drapers' Company has undertaken to give Oxford University £22,000 for a new electrical laboratory and £1,000 toward its equipment.

QUEEN'S UNIVERSITY, Ontario, has received from Dr. J. P. Thomson, Brisbane, a valuable collection of specimens for its museum.

THE graduating class of the Forest School of Yale University disbands on June 13, at the conclusion of their work in Alabama. Twenty-eight men out of a class of thirty-two will take the federal civil service examinations in forestry and nearly all of them will enter the government service.

DR. WALLACE CRAIG, of the University of Chicago, has been appointed to the chair of philosophy and psychology in the University of Maine.

DR. FRED W. THYNG, teaching fellow at Harvard University and in charge of the courses in biology at Tufts College the past year, is to be assistant in anatomy at the Northwestern University Medical School.

AT Cornell University appointments have been made as follows: Mr. David A. Molitor, who is now working on designs of the locks of the Panama Canal, professor of topographic and geodetic engineering; Dr. Sutherland Simpson, of the University of Edinburgh, professor of physiology; Dr. Andrew Hunter, of Leeds University, assistant professor of biochemistry; Dr. Dennie Hammond Udall, professor of veterinary medicine in Ohio State University, acting professor of the principles and practise of veterinary medicine, to succeed Dr. James Law; H. N. Ogden and V. Karapetoff, promoted to professorships of sanitary engineering and electrical engineering,

respectively; J. E. Trevor, professor of thermodynamics. In the Medical College in New York City: O. H. Schultze, assistant professor of pathological anatomy; J. S. Ferguson, assistant professor of histology; W. J. Elser, assistant professor of bacteriology. S. H. Gage was made professor of histology and embryology, emeritus, and James Law professor of the principles and practise of veterinary medicine, emeritus. Professors Gage and Law retire this year, as has been already announced, according to the provisions of the Carnegie Foundation.

The trustees of Princeton University have made the following appointments: Mr. Henry Jones Ford, of Baltimore, professor of politics, to succeed Professor Harry A. Garfield, who begins his administration as President of Williams College, his alma mater, next autumn; Henry Norris Russell '97 and Raymond Smith Dugan, assistant professors of astronomy; Gilbert Van Ingen, assistant professor of geology; John Gale Hun, Charles Ranald MacInnes and Carl Eben Stromquist, preceptors in mathematics; John Havron, Jr., instructor in civil engineering, and Frank Irwin, instructor in mathematics.

C. E. Porter has been appointed professor of botany at the University of Santiago de Chile.

At University College, London, Mr. H. Deans has been reappointed to lecture on railway engineering; Mr. A. T. Walmisley to lecture on waterways, docks and maritime engineering; and Mr. W. N. Blair to lecture on roads, street-paving and tramways, during the session 1908–09. Dr. C. Spearman has been reappointed reader in experimental psychology.

Mr. Richard Noel Gerrod Thomas has been appointed to a lectureship in physical chemistry at Balliol College, Oxford.

M. Raoul Bricard has been appointed professor of applied geometry in the Paris Observatoire des Arts et Métiers.

DISCUSSION AND CORRESPONDENCE

THE MENDELIAN INHERITANCE OF MUTATIONS

The revival of Mendel's writings and the extensive elaboration of the group of facts he discovered seem to have resulted in a corresponding neglect of the works of Darwin. A large amount of recent literature of Mendelism and mutation can be read without meeting any intimation that Darwin also studied and interpreted phenomena of the same kind. Darwin lacked, of course, the technical vocabulary of the modern Mendelian cult, but he made many observations and experiments, and collected a large series of pertinent facts from the records of earlier investigators. The conclusions he reached are very definite, and have not been refuted.

Darwin's fundamental discovery was that normal, constructive evolution is a gradual process. He did not fail to see that abrupt variations and Mendelian inheritance are not in accord with the idea of continuous changes in the characters of species, but he decided that such facts are not of primary importance in evolution. He understood that the characters of mutations are not necessarily new, and was aware that no complete inventory of the characters transmitted by a plant or animal can be made from the pedigrees of a few close-bred generations. He associated mutations with reversions and other monstrosities, and reckoned the Mendelian inheritance of mutations as a further evidence of abnormality.

When a character which has been lost in a breed reappears after a great number of generations, the most probable hypothesis is, not that one individual suddenly takes after an ancestor removed by some hundred generations, but that in each successive generation the character in question has been lying latent, and at last, under unknown favorable conditions, is developed.[1]

All the characters above enumerated, which are

[1] "Origin of Species," Chapter V. In the first edition (p. 160) the words of the sentence are somewhat different, but the same idea of persistent transmission and ultimate reappearance of ancestral characters is clearly conveyed: ". . . When a character which has been lost in a breed, reappears after a great number of generations, the most probable hypothesis is, not that the offspring suddenly takes after an ancestor some hundred generations distant, but that in

transmitted in a perfect state to some of the offspring and not to others—such as distinct colors, nakedness of skin, smoothness of leaves, absence of horns or tail, additional toes, pelorism, dwarfed structure, etc.—have all been known to appear suddenly in individual animals and plants. From this fact, and from the several slight, aggregated differences which distinguish domestic races and species from one another, not being liable to this peculiar form of transmission, we may conclude that it is in some way connected with the sudden appearance of the characters in question. . . . Some few characters, however, are incapable of fusion, but these are unimportant, as they are often of a semi-monstrous nature and have appeared suddenly.[2]

Writers on Mendelism have charitably assumed that only the accidental oversight of Mendel's writings kept Darwin from appreciating the new "principles of heredity." But in reality Darwin was acquainted with a much larger range of Mendelian facts than Mendel himself. Even the Mendelian proportions in the representation of the parental characters were not unknown to Darwin. Thus he found that reciprocal crosses between symmetrical and unsymmetrical snapdragons yielded only the ordinary unsymmetrical types of flowers in the first generation, while in about one quarter of the next generation (37 plants out of 127) the symmetrical character returned to expression.

Whether Darwin supposed that such proportions would remain regular in particular cases, does not appear, but there is no reason to believe that more knowledge on this point would have altered his conclusions, for he had facts to show that a general diversity of proportions attends "this peculiar form of transmission."

The proportions in which the parental characters are shown in Mendelian hybrids are not more exact than in the inheritance of sexual characters. Sex-inheritance is certainly a form of alternative expression, for the secondary characters of one sex are known in many instances to have been transmitted through the opposite sex. Characteristics of one sex can even be brought to expression in the other sex, as a result of castration, parasitism and disease. In sex-inheritance the contrasted characters of the parents secure expression in equal numbers of the offspring. In typical Mendelian inheritance the proportions are three to one, but the percentages are variable and are connected by intermediate numbers.

Mendelism is not a general phenomenon in nature, nor is it confined to distinct groups of animals or plants, or to particular kinds of characters. The Mendelian proportions simply mark one condition or stage of adjustment of variable physiological functions whose results can be traced from ordinary graded and blended expressions of parental differences, through many degrees of alternative expression, until they reach the highly specialized form of inheritance shown in sexual characters.[3]

Transmission is distinct from expression, just as the imprinting of an invisible image on a photographic plate by the light is distinct from the subsequent development of a visible image by solutions of chemicals. With organisms, as with photographs, different methods and conditions of development can bring different results from the same beginnings. The differences arise from the relations that govern expression, instead of from differences in the characters or in the methods of transmission. Reversions, mutations, sexual and Mendelian differences, and even the so-called environmental variations, can all be understood as varied combinations and degrees of expression of characters equally and impartially transmitted.[4]

Alternation in the expression of characters is an elective alternation, a choice among the transmitted characters of those that are

each successive generation there has been a tendency to reproduce the character in question, which at last, under unknown favorable conditions, gains an ascendancy."

[2] "The Variation of Animals and Plants under Domestication," Chapters XV. and XIX.

[3] "Mendelism and Other Methods of Descent," *Proc. Washington Acad. Sci.*, 9: 189–240.

[4] "Transmission Inheritance Distinct from Expression Inheritance," SCIENCE, N. S., 25: 911, 1907.

brought into expression. The Mendelian hypothesis of alternative transmission involves the idea of exclusion, of the formation of germ-cells which are "pure," in the sense that the protoplasmic rudiments of some of the parental characters are supposed to be omitted from some of the germ-cells. For the existence of such incomplete germ-cells only arithmetical reasons have been advanced.

If Mendel could have read the works of Darwin the hypothesis of *alternative transmission* might have been spared. His facts could have been associated with the many other instances of *alternative expression* enumerated by Darwin. Mendelism, as a theory of alternative *transmission* of characters, is still as lacking in a biological basis as in the days of Darwin. The conception of alternative *expression* of characters accommodates the facts better than the Mendelian conception of alternative transmission.

To represent the theories of mutation and Mendelism as emendations of Darwinism necessitated by the discovery of new facts is misleading. In reality these doctrines are fundamentally opposed to the Darwinian conception of evolution by gradual change in the characters of species. Darwinians have often gone too far in claiming that natural selection is the cause of evolution, but the theory of mutation departs as far from the truth in the opposite direction, in ascribing evolution to sudden jumps from one species to another, without any relation to selection.

There is no reason to suppose that sudden individual variations in uniform varieties represent new characters, except as symptoms of degeneration. Uniform varieties are special products of artificial selection or of isolation in nature. A series of mutants arising from the same uniform stock shows a range of individual diversity corresponding to that of the members of a natural, broad-bred species, though the mutants differ from the members of a normal species in frequent evidences of degeneration. Thus the mutations of a narrow-bred variety can be understood as representing the return to expression of characters transmitted from ancestors of much greater and more normal diversity.

O. F. Cook

Washington,
April 24, 1908

BIOTYPES OF CORN

To the Editor of Science: In my recent article, Science, June 5, I stated that Dr. Shull, in his investigations of the elementary species of corn, had been led to think that no biotype of corn had twelve rows, but that he had found those which tended to produce ten and fourteen rows. I further stated that Dr. East had been led, from his investigations, to believe that a type existed having twelve rows. This statement was made after having heard a fragmentary discussion between these gentlemen at the recent meeting of the American Breeders' Association.

Recent correspondence with both of these gentlemen shows that the point of discussion between them was as follows: Dr. East, in discussing Dr. Shull's paper, stated that he thinks there is a physiological reason for the ideal number of rows in corn biotypes to be in multiples of 4; and that therefore more biotypes will be found having 8, 12, 16, etc., rows than those having 10, 14, 18, etc., rows. Dr. Shull replied that in his work he had found no evidence that the multiples of 4 are more favored than the other multiples of 2.

W. J. Spillman
U. S. Department of Agriculture

QUOTATIONS

THE COLLEGE GRINDSTONE

The recently published "Life and Letters of Sir Richard Jebb" must fill the occupants of academic chairs in America with envious despair. This picture of the life of a college professor in Great Britain is far different from that of the college professor in America. It is different, of course, from that of the average university teacher in England; for Jebb was a man of exceptional parts; he was able to do large amounts of various kinds of work—teaching, investigating, lecturing and

writing—all of it brilliant. Nevertheless, he represents an ideal of accomplishment and achievement toward which the English university teacher more or less consciously strives. In America, on the other hand, this notion of the scholar and man of letters combined in one person is but dimly conceived by most members of the academic body; and it has apparently never entered the heads of many college trustees. We have had a Longfellow and a Lowell; and among the living we might name a few more who enjoy something beyond parochial fame; but the vast majority can hope to be nothing more than competent teachers and the editors of useful text-books—a respectable but not an inspiring career.

The reasons for this shortcoming—if we may use so harsh a word—are not far to seek. We need only refer to the fact that in but few places in this country is any tradition of culture firmly established. We have not half a dozen university seats where a man like Jebb would have received strong encouragement, to say nothing of stimulation. Moreover, he would be something of an alien within the university itself. The steady mediocrities and the glib talkers who figure so largely in our boards of trustees and who are not infrequently chosen to college presidencies, are naturally biased by an unconscious but none the less genuine distrust of men who are not of their own kind. These authorities, though they nominally desire to encourage scholarly production, really like best the solid teacher who carries a huge amount of class and committee work capably and without flinching, or that other one who dissipates his energies in keeping the college constituency "warm"—talking at all the teachers' meetings and similar gatherings. These are the activities that, in the eyes of college administrators, actually count, and therefore win solid rewards. Nor is this surprising. Most American colleges are much straitened for money. The one thing which they must do is to maintain the class-room instruction as well as may be, and keep growing in numbers so as to appeal to the public as an institution deserving of more liberal support. To these two ends other aims are, by the pressure of a growing population, clamorous alumni, and an empty treasury, ruthlessly sacrificed.

To the merchants, manufacturers and bankers, who constitute the backbone of our intelligent and public-spirited boards of trustees, it appears absurd that a professor should find fifteen or twenty hours of class-work a week a heavy load. Three or four hours of teaching or lecturing a day, for nine months in the year, seems to your business man mere play. Yet the truth is that six or eight hours a week of first-rate class work, informed as to the latest results of research, thoroughly digested, and carefully presented, will keep a professor busy. If he attempts more, he degenerates into a machine; he offers the same lectures and cracks the same jokes year after year; he becomes a mere dealer in routine. That is, he has no chance to refresh himself, to get new points of view, in fine, to think. For the professor the time spent in experimentation that is not immediately productive of striking results, in reading, in mulling over his ideas while he walks, plays golf, or rides the bicycle, and in discussing with a colleague the newest theory as to the constitution of matter or the recently discovered fragment of Menander, is not pure loafing or genteel recreation. This is the very process by which he subjugates his facts, assimilates his learning, and ripens his scholarship. But the unhappy truth is that thinking is a luxury in which our average underpaid and over-driven college teacher can not afford to indulge. Whatever his personal inclinations, he knows that the people to whom he must look for approval, for means to extend his department, for library books and laboratory apparatus, for bread and butter for himself and his children—that these people are primarily interested in other things; and that he is at liberty to do only so much thinking as is compatible with devoting all his time and energy to classes and committees.—New York *Evening Post.*

SCIENTIFIC BOOKS

Text Books of Physical Chemistry. Stoichiometry. By SYDNEY YOUNG, D.Sc., F.R.S., Professor of Chemistry in the University of

Dublin. Together with an introduction to the Study of Physical Chemistry, by Sir William Ramsay, K.C.B., F.R.S. Pp. lxi + 381. London, Longmans, Green and Co. 1908.

The term stoichiometry which originally was applied to the calculation of chemical equivalents has been extended by Ostwald to include not only the determination of atomic and molecular weights, but the study of the properties of solids, liquids, gases and solutions as well. It is in this broader sense that the author uses the word in the title of the present volume, which may be regarded as the most satisfactory of this admirable series of texts which we owe to Professor Ramsay.

Unfortunately many of the text-books which appear nowadays are characterized by a sort of inbreeding, each one reading like a reassortment of the sterotyped pages of its predecessors. This fault the author has avoided to a remarkable degree. The interest of the reader is held not only by the refreshing novelty of the treatment but also by the introduction of much comparatively unfamiliar material and many new tables and figures. If a criticism were to be made it would be that the author's zeal in the exposition of experimental results has caused him to neglect those fundamental thermodynamic considerations which would have added much to the symmetry and logical completeness of his work.

Never has a simple experiment, carried out with the highest accuracy and scientific honesty, been rewarded by more signal consequences than Lord Raleigh's determination of the density of nitrogen. The continued study of the small discrepancies which he found, and which might have been glossed over by a less critical observer, have led directly on the one hand to the discovery of the five new elements of the argon family, and on the other to the complete revision of our accepted table of atomic weights. The work of D. Berthelot, Guye and others has established the complete validity, at very small gas pressures, of the principle of Avogadro, and has enabled them by physico-chemical means alone to determine the atomic weights of a considerable number of elements with an accuracy which rivals that attained in the most refined chemical analyses. How this method has led to a notable amendment of Stas's value for the atomic weight of nitrogen, and thence indirectly to a modification of many other important atomic weights, is fully described by the author. He discusses also some of the more important determinations which have been made by chemical means and shows the futility in such cases of the calculation of the so-called probable error, a point which he might well emphasize more strongly.

In the chapters on liquids, the critical state, and liquid mixtures Professor Young deals with subjects to which his life has been devoted. The reader expects therefore a comprehensive and stimulating treatment and he is not disappointed.

The introduction to physical chemistry by Professor Ramsay which is included in this book has already appeared in another volume of the series. It is a very compact statement, along conventional lines, of the historical development of chemical theory. The reviewer notes one paragraph, on solubility, page xxxv, which may be very misleading to a beginner.

Gilbert N. Lewis

Behind the Scenes with the Mediums. By David P. Abbott. Chicago, The Open Court Publishing Co. 1906. 8vo, pp. 328.

To the psychologist or layman interested in the *modus operandi* of deception, this painstaking book by Mr. Abbott will prove as invaluable as it is interesting. It brings home with renewed emphasis the technical expertness that goes into the performances of the modern mystifier, particularly of the type that appeals to the spiritualistic or other prepossessions of the sitters. It emphasizes equally how unevenly matched must be this mystifier and the ordinary or even the extraordinary investigator who interprets his inability to discover how the effect is produced into a warrant for the belief that something defying natural experience has been witnessed. In the face of such manifold and complex procedures, the assurance of even the sincere

and observant that their watchfulness precluded any such varieties of deceit appears most feeble. When one considers the difficulty of describing in proper sequence and with sufficient detail an ordinary procedure, the impossibility of deciphering a performance studiously devised to conceal every item of its real purpose becomes glaringly evident.

The largest amount of ingenuity seems to have been expended in the devising of tricks that shall reveal knowledge apparently out of range of the performer's sphere of influence. The reading of sealed billets is a favorite device and is endlessly variable in procedure, running the gamut of manifolding paper, chemically revealed impressions, the substitution of prepared messages, the intrusion of confederates, concealed speaking tubes and telephones, and codes of signals of some measure of resourcefulness, to say nothing of prepared "blue books" of gossipy information for each town visited and the helpful *esprit de corps* of the profession. At times there is a skillful service of simple physical principles with an appropriate translation into the mystifying terminology. A clever device by which any one of a series of pendulums will begin to respond by taps against the sides of the glass in which it is suspended, is managed by the performer's giving an impact to the table upon which the glasses stand and timing his gentle pushes with the period of the pendulum designated. The pendulums are all made of slightly different lengths; and with a little practise the right one is set going, to the perplexity of the sitters. Even an ordinary magnet embedded in a plaster hand is sufficient to serve as the medium of "thought vibrations," while telescopic projecting rods that disturb furniture ten feet off become the proof for the moving of objects without contact. Such are the things undreamt of in the philosophy which our forefathers designated "natural" and which in these practical generations ministers to the needs of so varied interests as physics, parlor entertainments, and a belief in the survival of materializing and materialized spirits.

Nothing less than a reading of the volume will convey an adequate sense of the versatility of device, yet in individual cases of the poverty of resource and obviousness of deception that make up the professional equipment of the medium. Such reading is eminently to be recommended, and is nowhere to be found in more convincing form than in Mr. Abbott's narrative. The very directness and simplicity of the story argues its singleness of purpose; which is the matter-of-fact enlightenment of the *modus operandi*. This in turn is doubly convincing by the fact that Mr. Abbott himself has tried and tested that whereof he speaks, has produced the effects described, has gained the confidence of the mediums, who have in some cases adopted the devices of Mr. Abbott's performances (which it is needless to state were given merely as effects by natural means to be explained by the sitters as their judgments dictated), and has cultivated for years the field in which he is expert. It is for these reasons that the practical value of the book, both as a record, and as a rationalizing instrument, is quite sufficient to deserve a word of appreciation on the part of those interested in spreading the gospel of common sense and sound science.

The psychological aspects of deception are not specifically treated, but appear conspicuously between the lines. The mental physiognomy of the species "medium" stands revealed in recognizable though variable features. It presents usually a somewhat bourgeois, coarse, temperament, attracted by the ready gullibility of the clientele and the get-rich-quick instincts of the adventurer, and with this combines a variable stock in trade in a commanding presence, an insinuating manner, a shrewd observation, a bold finesse, or a real even if somewhat criminal interest in playing the game and winning. A medium who actually bullied his sitters to provide the proper moment for picking their pockets (to extract a letter or other document to obtain name and address) is thus described: "The medium was a very large and powerful man . . . at one time he had been a pugilist. After this he became a minister of the Gospel, finally taking up the profession of a spirit medium, as this was more lucrative for one of his talents and personal appearance." In

other social circles the type may appear thus. "There is a lady medium in Omaha who is the wife of a prominent citizen. She is afflicted, being nearly blind. This lady, in her seances, produces large quantities of cut flowers, which she claims to materialize from their 'astral forms.' Most persons would think that a lady of her standing, and afflicted in the manner she is, would not deceive." The flowers are real flowers, and the medium allows ladies to examine her clothing to see that no flowers are concealed about her person. Yet no one pays attention to a confederate under whose ample skirts the "astral" flowers take shelter until needed, nor is the public aware of regular consignments of flowers to the medium from "a greenhouse in Council Bluffs." As to the psychology of the sitters, it is doubtless complex and divisible into many types. In the main it is not the performance that convinces against protest and despite intellectual antagonism; but rather that prepossession finds support in seeming mystery and flies to evils that it knows not of. The most common trait is the assurance that in the case observed there really was no room for trickery or malobservation. Why such assurance should be so common a trait it is not easy to explain. One wishes for such persons the attitude attributed (possibly without due warrant) to Sir Walter Scott: when asked whether he believed in ghosts, he is said to have replied, "No! I have seen too many of them."

J. J.

A UNIQUE COLLECTION OF PERIDOTITE

State Mineralogist J. F. Whitlack, of Little Rock, Ark., has recently arranged and placed on exhibition at the Bureau of Mines, Manufactures and Agriculture, a unique collection of peridotite which is attracting much attention.

The collection contains specimens of the peculiar peridotite breccia from the three well-known American localities, those of Arkansas, Kentucky and New York, arranged side by side with similar rock and concentrates from the most noted of the African mines, indicating more forcibly than could a lengthy description the extremely close resemblance between the rocks of these widely separated localities. So close is the resemblance between the peridotites from these various localities, as shown by the specimens both rough and polished, that it is almost impossible to distinguish between them.

The rock is a dark green, almost black, porphyritic mass composed largely of grains and crystals of olivene. The tendency of this mineral to alteration is well known, and specimens of the alteration products—the green and yellow serpentinous earths from the various localities—are also shown. These earthy products are interesting economically as well as scientifically, for it is by washing and screening them that the heavy concentrates are obtained from which the diamond and other gems are subsequently sorted. The collection thus shows the various stages through which the rock passes from practically the fresh unweathered condition through the partly altered peridotites into the softer green and yellow earths to the concentrate of pebbles and gems. Besides the much prized diamond the latter includes the light green olivene, bright red garnet and deep blue diopside crystals. The last named has not as yet been recognized in the Arkansas deposits.

To the scientist the problem of explaining how these gems come to be locked up in this peculiar volcanic material is of greater interest than the question of securing them, and it is hoped that a study of the conditions at some of these localities may explain the perplexing problem. At several of the occurrences the diamondiferous peridotite penetrates beds of shales rich in carbon, hence it has been suggested that the diamond, which is merely crystallized carbon, owes its presence to the fact that the heated material forced its way as a partially liquid mass through the adjoining carbon-bearing shales, absorbing some of their carbon which later crystallized from the cooling magma as the diamond. This plausible hypothesis would no doubt still be regarded as the true explanation were it not for the fact that at several of the diamond mines no carbon shales are known, hence the diamond could not have been derived from

this source. At present opinion is divided as to whether the diamond should be considered a constituent of the rock itself as is the mica, garnet, ilmenite, etc., or whether it has crystallized at great depths and merely been brought upward by the peridotite.

The discovery of diamonds at one of the American peridotite localities is causing some speculation as to whether the other two localities where this rock is known to occur and to contain the accessory minerals which so frequently accompany that gem, may not also contain the diamond. The remarkable similarity of the rocks at all three of the American localities with those of South Africa, not only in appearance as indicated in the collection mentioned, but also in eruptive character, in inclusions, in structure and in chemical composition, as has been frequently noted, makes such a supposition not improbable.

A catalogue describing the rocks of this collection in detail, together with a bulletin outlining the important facts concerning the Arkansas diamond field has been issued by Commissioner Guy B. Tucker, of the Bureau of Mines, Manufactures and Agriculture. Either of these may be obtained by applying to the Commissioner of Mines, Little Rock, Arkansas.

PHILIP F. SCHNEIDER

LITTLE ROCK, ARK.

SPECIAL ARTICLES

THE EFFECT OF AN ANGLE IN A CONDUCTOR ON SPARK DISCHARGE

AT a recent meeting of the American Philosophical Society held in Philadelphia the writer gave the preliminary results of his experimental work to determine the direction of flow of the electrical current in a wire. A large, eight-plate "static" machine, enclosed in a glass case containing also the Leyden jars, was used as a source of electricity.

The positive and negative discharges are led to two large metal cylinders hung in the air on insulators, and armed with a multitude of pin-points. In this way the positive and negative discharges are not superposed in the same conductor. The discharge was led around a sharply made right angle in the wire. This was done by means of a small splinter of bamboo, forming a sharp edge. A photographic plate in a holder of hard rubber was placed under the angle so that the discharge could be sent downward to the angle and then led horizontally away over the plate holder.

By reversing distant connections made by two small wires, the discharge could also be sent around the angle in the opposite direction.

The plate holder rests on a large sheet of plate glass forming a table top. Below this sheet of glass is a plate of metal connected to the water pipe. Its distance from the photographic plate may be varied. In all of the work done on the negative discharge this plate was not needed. Its use does not change the nature of the result.

It is found that when the negative discharge plunges down to the angle the electrical particles pass on into the air and through the rubber cover, whose thickness is three sixteenths of an inch, to the photographic film. This is shown by the character of the image formed on developing the plate. If the action is too strong, the electrical stresses produce branching images due to incipient breaking down of the film. By diminishing the spark length or by removing the angle further from the film, the image becomes a round spot just under the wire carrying the downward discharge. This image is apparently of the same character as is produced by X-rays or radio-action.

When the discharge is reversed, so that the negative particles pass across the plate to the angle and then upwards, the spot is much feebler, or does not form at all. The result depends somewhat on the extent to which the discharge is an oscillatory one. Oscillations are to be prevented.

When the positive discharge is sent around the angle, no such effect is produced. This is the case even when the grounded plate is brought as near as is possible without inducing spark discharges over the plate-holder. In such cases, however, the plate may be fogged by negative action from below, and

proceeding from the plate grounded on the water pipe.

By the use of this grounded plate and by replacing the thick hard-rubber cover of the plate holder by a thin sheet of black paper, in two cases distinct images have been produced by the positive discharge. In this case only a few millimeters of air separated the discharge wire from the film. It is then, however, very difficult to prevent the electric stresses from forming the branching images. When this begins the results are quite uncertain. When a negative discharge of the same spark length is used under the conditions which gave the faint positive image, the image produced covers a couple of square inches of plate. Five spark discharges of the negative produce a much greater effect than was produced by a hundred of the positive, in the two cases when the latter discharge produced any effect. The behavior of the positive line is somewhat perplexing. An X-ray tube will operate in this line, the cathode being connected on the cylinder hung in air. But these cathode particles do not appear to be active at the angle.

It may be possible to devise some method of electrometer examination which will not result in the destruction of the instrument. The continuous current has not yet been examined. This, however, involves different conditions from those existing in the circuits here examined. There are many precautions necessary in this work which can not be here discussed, but which will be presented as soon as final results can be given. It has required the use of sixty dozen photographic plates in order to reach the results already attained.

It is evident that the effects here described point to the action of the β and α "rays," in radio-active phenomena.

Francis E. Nipher

DINICHTHYS INTERMEDIUS NEWBERRY FROM THE HURON SHALE

In the spring of 1907 Dr. Lynds Jones found part of a dinichthyid mandible in the Huron shale near Huron, Ohio, and the writer collected it for the Geological Museum of Oberlin College. The specimen includes all of the cutting blade of the mandible excepting about one centimeter of the posterior end. The length of the cutting blade is sixteen centimeters. This indicates that the entire length of the mandible was about thirty-five centimeters. The width is eleven centimeters. In size it agrees with mandibles of *Dinichthys intermedius* Newb. and in form it agrees closely with the same species, differing in the greater and more regular concavity of the top between the second cusp and the posterior end of the cutting edge, and in the prominence of the cusp-like projection between the anterior tooth and the main cusp. As pointed out by Hussakof,[1] the prominence of this projection is probably an individual variation and is not of specific value. In the writer's opinion the first difference mentioned is not of specific value. The denticles on the posterior part of the cutting edge are smaller than in most specimens of *Dinichthys intermedius*. Teeth are absent from that part of the jaw where they are prominent in *Dinichthys hertzeri*. The differences between this mandible and those of *Dinichthys intermedius* are so slight that the writer has no hesitation in referring it to that species. The specimen is important in demonstrating the presence of a second species of *Dinichthys* in the Huron shale and in showing that the type of mandible of *Dinichthys intermedius* and *Dinichthys terrelli* did not develop from the *Dinichthys hertzeri* type.

A figure of this specimen will be published later with figures of other specimens recently collected from the Huron shale.

E. B. Branson

Geological Department,
Oberlin College

SOCIETIES AND ACADEMIES

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

The twenty-eighth meeting of the society was held in the physiological laboratory of the New York University and Bellevue Hospital Medical College, April 15, 1908. President Lee in the chair.

Members elected.—Otto C. Glaser, Alfred G. Mayer, John B. Murphy, Isaac Ott.

[1] *Bull. Am. Mus. Nat. Hist.*, Vol. XXI., p. 411.

Program[1]

"Influence of Cold and Exercise in Phlorhizin Glycosuria," by Graham Lusk.

"The Influence of Carbohydrate on the Protein Metabolism of a Fasting Pregnant Dog," by J. R. Murlin.

"The Transplantation of Parathyroid Glands in Dogs," by W. S. Halsted.

"The Nervous Coordination of the Auricles and Ventricle of the Heart of the Lizard," by Marie Imchanitzky. (Communicated by S. J. Meltzer.)

"The Influence of Diet on the Chemical Composition of the Body," by Lafayette B. Mendel.

"The Chemical Composition of Nonstriated Mammalian Muscle," by Lafayette B. Mendel and Tadasu Saiki.

"Increased Susceptibility of Protozoa to Poison due to Treatment with Alcohol," by Lorande Loss Woodruff.

"The Relative Specificity of Anaphylaxis," by F. P. Gay and E. E. Southard.

"On the Relation of Calcium Metabolism to Tetany and the Cure of Tetany by Administration of Calcium," by W. G. MacCallum and Carl Voegtlin.

"The Relative Toxicity of the Chlorides of Magnesium, Calcium, Potassium and Sodium," by Don R. Joseph and S. J. Meltzer.

"The Action of Calcium upon the Pupil and its Relation to the Effects of Mydriatics," by John Auer and S. J. Meltzer.

"The Destruction of Strophanthin in the Animal Organism," by Robert A. Hatcher and Harold C. Bailey.

"On the Nature of the So-called Glycogenolytic Fibers in the Greater Splanchnic Nerves," by J. J. R. Macleod.

"Prevention of Syphilis in Macacus Rhesus by Atoxyl," by Simon Flexner.

"Further Notes on a Rat Tumor," by Simon Flexner and J. W. Jobling.

"On Nucleic Acids," by John A. Mandel, W. A. Jacobs and P. A. Levene.

"Regarding the Innervation of the Blood Vessels of the Kidney," by R. Burton-Opitz and Daniel R. Lucas.

[1] Authors' abstracts of the papers read before the Society for Experimental Biology and Medicine are published in the *Proceedings of the Society for Experimental Biology and Medicine*. A number is issued shortly after each meeting, and costs 15 cents a copy. Copies may be obtained from the managing editor, William J. Gies, 437 West 59th Street, New York.

"Regarding the Innervation of the Blood Vessels of the Intestine," by R. Burton-Opitz.

"Note on Anaphylaxis to Horse Serum," by Paul A. Lewis.

"A Study of 'Protagon' prepared by the Wilson-Cramer Method," by L. J. Cohen and William J. Gies.

THE twenty-ninth meeting of the society was held at Cornell Medical College, May 20, 1908. Silas P. Beebe in the chair.

Program

"Heredity of some Human Physical Characteristics," by C. B. Davenport.

"The Experimental Production of the Maternal Part of the Placenta in the Rabbit," by Leo Loeb.

"Hemolytic Action of the Venom of *Heloderma suspectum*," by Elizabeth Cooke and Leo Loeb.

"The Biological Relations of Seed Proteins," by Thomas B. Osborne.

"Variation in Hydrochloric Acid Secretion during the Digestive Period," by Nellis B. Foster and Adrian V. S. Lambert.

"The Effects of some Organic Acids on the Secretion of Gastric Juice," by Nellis B. Foster and Adrian V. S. Lambert.

"The Effect of Mechanical Obstruction of the Pyloric Outlet on Gastric Secretion," by Nellis B. Foster and Adrian V. S. Lambert.

"Transplantation of Devitalized Arterial Segments," by Isaac Levin and John H. Larkin.

"A Study of Nitrogen Metabolism in a Case Presenting Short Paroxysms of Fever of Unknown Origin," by Theodore C. Janeway and Herman O. Mosenthal.

"Histological Changes in Transplanted Blood Vessels," by Wilbur Ward. (Communicated by Francis Carter Wood.)

"Note upon the Supposed Presence of a Gastric Hormon in the Salivary Glands," by A. S. Loevenhart and D. R. Hooker.

"The Relation of the Weight of the Stomach- and Cecum-contents to the Body Weight in Rabbits," by Don R. Joseph.

"The Inhibitory Influence of Magnesium upon some of the Toxic Effects of Eserin," by Don R. Joseph.

"Influence of Iodides on Autolysis," by L. B. Stookey.

"Relation of the Thyroids to Autolysis," by L. B. Stookey and Vera Gardner.

"On the Physiology of the Thyroids," by L. B. Stookey.

"On the Pharmacology of the Iodides," by L. B. Stookey and Vera Gardner.

"Glycogen Formation from Arabinose in Chicks," by L. B. Stookey and A. Halden Jones.

"Is Oxalic Acid a Product of Hepatic Uricolysis in Man?" by L. B. Stookey and Ethel L. Leonard.

"The Life Cycle of Paramecium," by Lorande Loss Woodruff.

"An Examination of Bardach's New Protein Test," by Emily C. Seaman and William J. Gies.

"A Study of Metabolic Effects of Experimental Polycythemia in Dogs," by William Weinberger (by invitation).

"On the Metabolic Influence of Magnesium Sulfate in Dogs, with Special Reference to the Partition of the Nitrogenous Constituents of the Urine," by Matthew Steel (by invitation.)

"On the Determination of Ammonia, by the Folin Method, in Urines containing Crystalline Ammonio-magnesium Phosphate," by Matthew Steel and William J. Gies.

WILLIAM J. GIES,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 206th meeting of the society Mr. C. W. Wright presented a "Brief Discussion of the Copper Deposits of Kasaan Peninsula, Southeastern Alaska." He first stated briefly the general geology of Kasaan Peninsula and then described the occurrence of the copper and its possible origin. Greenstone lavas, tuffs, conglomerates, sandstones and limestones constitute the stratified rocks and intruding these are batholithic masses of granodiorite. Granite and syenite dikes invade the granodiorite and in turn are cut by dikes of porphyry, felsite, diabase and basalt. Three types of ore deposits are recognized: (1) Chalcopyrite-magnetite deposits associated with amphibole, epidote, garnet and orthoclase, and occurring as irregular masses 10 to 300 feet in dimensions along the contacts of the intrusives. (2) Chalcopyrite-pyrite-sphalerite deposits associated with quartz and calcite and occurring in fissures or sheer zones 5 to 10 feet wide in the greenstone tuffs. (3) Galena-sphalerite-chalcopyrite and tetrahedrite deposits associated with quartz calcite and barite and occupying fissures 2 to 8 feet wide in the limestones. The first type are commercially the most important, and were described more fully. The facts relative to the origin of these contact metamorphic deposits are: (1) that a considerable transfer of material to local points at the intrusive contacts took place, (2) that the ore-bodies were deposited after the solidification of those portions of the adjacent intrusives now exposed, (3) that the minerals contained are those which form at relatively high temperatures from gaseous or aqueous solutions, (4) that the contacts of the intrusives have been favorable localities for the passage of these solutions. Though the source of these mineral solutions is hypothetical they are believed to have been derived from an underlying magma and probably the same magma from which the granodiorite, granite and syenite were ejected. Evidence tends to show that the origin of the copper deposits can not be attributed directly to the adjacent intrusive rocks and that both the intrusive and intruded enclosing rocks have played but a passive rôle in their formation. Their genesis is referred to an underlying igneous magma from which the greater portion of the material composing the ore deposits was ejected in a gaseous or aqueous state at a period subsequent to the ejection of the intrusive rocks with which the copper deposits occur.

RALPH ARNOLD,
Secretary

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

THE American Institute of Chemical Engineers was organized on June 22 at the Engineers' Club of Philadelphia. The following officers were elected for a term expiring at the next regular meeting, which will be held in December:

President—Samuel P. Sadtler, Philadelphia, Pa.
First Vice-President—Charles F. McKenna, New York City, N. Y.
Second Vice-President—H. Aug. Hunicke, St. Louis, Mo.
Third Vice-President—E. G. Acheson, Niagara Falls, N. Y.
Treasurer—William M. Booth, Syracuse, N. Y.
Secretary—John C. Olsen, Brooklyn, N. Y.
Auditor—Richard K. Meade, Nazareth, Pa.

Directors were elected for terms of one, two or three years as follows:

One year—Ludwig Reuter, Berkeley, Cal.; Thorne Smith, Isabelle, Tenn.; H. P. Brown, Wilmington, Del.

Two years—J. M. Camp, Duquesne, Pa.; Charles A. Catlin, Providence, R. I.; Eugene Haanel, Ottawa, Canada.

Three years—George P. Adamson, Easton, Pa.; David Wesson, Wilmington, Del.; Edward Gudeman, Chicago, Ill.

DAVID WILBUR HORN,
Secretary pro tem.